PJM November 2013 Queue Generation Affected System Impact Study

August 5, 2014

MISO
720 City Center Drive
Carmel
Indiana - 46032
http://www.misoenergy.org

Table of Contents

List of Tables

1 Executive Summary

This report documents the system impacts of twenty-three (23) projects in the PJM generator interconnection queue on the Midcontinent Independent System Operator ("MISO") transmission system. The projects are listed in Table 1-1.

Table 1-1 List of PJM Group Generation Interconnection Projects

Queue	Project Name	Pmax (MW)	Size (MW)	Fuel Type	State	TO	County
V1-024	LaSalle 1	1188.0	20.0	nuclear	IL	ComEd	LaSalle
V1-025	LaSalle 2	1191.0	20.0	nuclear	IL	ComEd	LaSalle
V4-046	Byron 1	1249.0	20.0	nuclear	IL	ComEd	Ogle
V4-047	Byron 2	1223.0	20.0	nuclear	IL	ComEd	Ogle
V4-048	Braidwood 1	1247.0	20.0	nuclear	IL	ComEd	Will
V4-049	Braidwood 2	1219.0	20.0	nuclear	IL	ComEd	Will
W2-048	Pontiac MidPoint – Lanesville 345kV	63.0	62.5	wind	IL	ComEd	Logan
W3-046	Powerton 345kV – Katydid 345kV	208.0	208.0	wind	IL	ComEd	Mason
W4-005	Pontiac Midpoint – Latham 345kV	351.0	351.0	wind	IL	ComEd	Macon
X1-096	Loretto-Kings Creek 138kV	150.0	150.0	wind	MD	DPL	Somerset
X2-022	Pontiac Midpoint-Lanesville II	189.0	189.0	wind	IL	ComEd	Logan
X2-031	Krayn 115kV	50.0	50.0	wind	PA	PENELEC	Cambria
X2-052	Dumont-Olive 345kV	675.0	675.0	natural gas	IN	AEP	Adams
X3-051	Flatlick 765kV	1460.0	610.0	natural gas	OH	AEP	Unknown
X4-020	Peach Bottom-TMI #1 500kV I	800.0	800.0	natural gas	PA	PPL	York
X4-021	Peach Bottom-TMI #2 500kV II	320.0	320.0	natural gas	PA	PPL	York
X4-025	Millbrook Park 138kV	80.0	80.0	coal	KY	AEP	Greenup
Y1-015	Shenango – Hoytdale 345kV	1000.0	1000.0	natural gas	PA	ATSI	Lawrence
Y1-030	Forest 69kV	100.0	100.0	wind	OH	AEP	Wyandot
Y1-035	Eastlake 138kV	462.0	462.0	natural gas	OH	ATSI	Lake
Y1-036	Eastlake 345kV	462.0	462.0	natural gas	OH	ATSI	Lake
Y1-065	Rock Spring 500kV	852.0	852.0	natural gas	MD	ODEC	Cecil
Total			**6491.5**				

Steady State AC analysis was performed to identify any reliability criteria violations caused by the study generators. The study did identify constraints in the off peak scenario under both the near term (2016) and the out year (2023) analysis. Network upgrades were identified and cost allocation was performed. A summary of cost estimates identified for each scenario is provided in Table 1-2, detailed information regarding network upgrades is provided in section 3 of the report. Per project cost allocation responsibilities are listed in Table 1-3.

Table 1-2 Cost Estimate for Proposed Network Upgrades

Monitored Element	Near Term Mitigation Cost	Out Year Mitigation Cost
MUNSTER - BURNHAM 345 kV Line	$780,000	
LAPORTE – MICHIGAN CITY 138 kV Line	$2,215,000	
ST JOHN – CRETE 345 kV Line	$200,000	
NEWCARLISLE – TRAILCREEK 138kV Line		$1,717,000
MICHIGAN CITY- TRAIL CREEK 138 kV Line	$668,000	$918,000
HONEYCREEK – MONTICELLO 69kV Line	$0	
HONEYCREEK – SEAFIELD 69kV Line	$0	
Total cost of upgrades	**$3,863,000**	**$2,635,000**

Table 1-3 Cost Allocation per Project

Project	Project Name	Near Term Cost	Out year Cost
V1-024	LaSalle 1	$28,705	
V1-025	LaSalle 2	$28,707	
V4-046	Byron 1	$25,453	
V4-047	Byron 2	$25,455	
V4-048	Braidwood 1	$29,161	
V4-049	Braidwood 2	$29,188	
W2-048	Pontiac MidPoint – Lanesville 345kV	$49,988	
W3-046	Powerton 345kV – Katydid 345kV	$277,899	
W4-005	Pontiac Midpoint – Latham 345kV	$3,217,277	$2,635,000
X1-096	Loretto-Kings Creek 138kV		
X2-022	Pontiac Midpoint-Lanesville II	$151,165	
X2-031	Krayn 115kV		
X2-052	Dumont-Olive 345kV		
X3-051	Flatlick 765kV		
X4-020	Peach Bottom-TMI #1 500kV I		
X4-021	Peach Bottom-TMI #2 500kV II		
X4-025	Millbrook Park 138kV		
Y1-015	Shenango – Hoytdale 345kV		
Y1-030	Forest 69kV		
Y1-035	Eastlake 138kV		
Y1-036	Eastlake 345kV		

2 Study Methodology & Assumptions

2.1 Study Criteria

All interconnection requirements are based on the applicable MISO Interconnection Planning Criteria and in accordance with the NERC Reliability Standards. Steady state violations of applicable planning criteria were attributed to the PJM group generation requests by the usage of MISO injection criteria, and applicable local planning criteria, especially, Northern Indiana Power Service Co. (NIPSCO) generation interconnection criteria.

2.2 Contingency Criteria

A comprehensive list of contingencies was considered for steady-state AC contingency analysis:

- NERC Category A with system intact
- NERC Category B contingencies
    - Single element outages, at buses with a nominal voltage of 69 kV and above, in the following areas: NIPS (area 217), DEI (area 208), IPL (area 216), MEC (area 635), CWLD (area 333), AMMO (area 356), AMIL (area 357), CWLP (area 360), CE (area 222), AEP (area 205).
    - Multiple-element outages initiated by a fault with normal clearing such as multi-terminal lines, in AEP, CE, Ameren, MEC, CWLP, DEI, IPL, NIPS.
- NERC Category C contingencies
    - Selected NERC Category C events.

2.3 Monitored Elements

Table 2-1 Monitored Area outlines the list of areas monitored for this study. All facilities in the study region with a voltage of 69kV and above were monitored.

Table 2-1 Monitored Area

Area #	Area ID	Area Name
207	HE	Hoosier Energy
208	DEI	Duke Energy Indiana
210	SIGE	Southern Indiana Gas & Electric Company
216	IPL	Indianapolis Power & Light Company
217	NIPS	Northern Indiana Public Service Company
333	CWLD	Columbia, MO Water and Light
356	AMMO	Ameren Missouri
357	AMIL	Ameren Illinois
360	CWLP	City of Springfield (IL) Water Light & Power
361	SIPC	Southern Illinois Power Cooperative
295	WEC	Wisconsin Electric Power Company (ATC)

Area #	Area ID	Area Name
600	XEL	Xcel Energy North
608	MP	Minnesota Power & Light
613	SMMPA	Southern Minnesota Municipal Power Association
615	GRE	Great River Energy
620	OTP	Otter Tail Power Company
627	ALTW	Alliant Energy West
633	MPW	Muscatine Power & Water
635	MEC	MidAmerican Energy
661	MDU	Montana-Dakota Utilities Co.
680	DPC	Dairyland Power Cooperative
694	ALTE	Alliant Energy East (ATC)
696	WPC	Wisconsin Public Service Corporation (ATC)
697	MGE	Madison Gas and Electric Company (ATC)
698	UPPC	Upper Peninsula Power Company (ATC)

2.4 Model Development

The following base cases were used for the study:

- StudyCase-DPP-Aug13_2016SPK_v32_MUST_131031.sav
- StudyCase-DPP-Aug13_2016SH_v32_MUST_131031.sav
- StudyCase-DPP-Aug13_2023SH_v32_MUST_131031.sav
- StudyCase-DPP-Aug13_2023SPK_v32_MUST_131101.sav

The study cases were built by adding and dispatching the appropriate queue projects to the base cases. The detail of each PJM interconnection request is listed in Table 1-1. The study projects were dispatched to the entire PJM footprint, where generator was scaled in proportion to the available reserve.

2.5 Study Assumptions

This affected system impact study was conducted with all the PJM November 2013 participating generators operating together as a group. Analysis was not performed on individual generating units or subsets of the generating units unless specifically noted otherwise. Higher queued PJM projects were modeled as outlined in Appendix A of the report. The results obtained in this analysis will change if any of the data or assumptions which were made during the development of the study models is revised.

3 Steady State Analysis

3.1 Near Term (2016) Analysis

Criteria violations were identified in the near term analysis for the off peak scenario. The summer peak analysis did not identify any violations. The following table lists the constraints identified. All constraints identified in the analysis violate the affected system's (NIPSCO) local planning criteria. NIPSCO's Generation Interconnection criteria can be found under section 4.5 of the planning methodology document available at:

https://www.misoenergy.org/Library/Repository/Study/TO%20Planning%20Criteria/NIPSCO%20TO%20Planning%20Criteria.pdf

Table 3-1 Near-Term Constraints

Monitored Element	Cont Flow (MVA)	Rating (MVA)	Loading %	Contingency	Contingency Category	Constraint criteria
ST JOHN – CRETE 345 kV Line	1530	1195	128	AEP_Dumont_B1	Cat C2	NIPS DF
MUNSTER - BURNHAM 345 kV Line	1235	1195	103	AEP_Dumont_B1	Cat C2	NIPS DF
LAPORTE – MICHIGAN CITY 138 kV Line	181	156	116	AEPCE_DUMWIL	Cat B2	NIPS Facility Impact
MICHIGAN CITY- TRAIL CREEK 138 kV Line	175	156	112	AEPCE_DUMWIL	Cat B2	NIPS Facility Impact
HONEYCREEK – MONTICELLO 69kV Line	75	41	182	255129 17GOODLAND 138 255173 17REYNOLDS 138 1	Cat B2	NIPS Facility Impact
HONEYCREEK – SEAFIELD 69kV Line	67	41	164	255129 17GOODLAND 138 255173 17REYNOLDS 138 1	Cat B2	NIPS Facility Impact

Proposed Network Upgrades (NU) for mitigating the constraints identified in the Near-term (2016) scenario are listed in Table 3-2.

Table 3-2 Proposed Near-Term Network Upgrades

Monitored Element	Constraint	Mitigation	Planning Level Estimate	Queue Projects with Impacts
LAPORTE – MICHIGAN CITY 138 kV Line	Sag limit	Remove Sag Limit	$2,215,000	W4-005
MUNSTER - BURNHAM 345 kV Line	Breaker and disconnect switches.	Upgrade breaker and two switches to 3000A	$780,000	V1-024, V1-025, V4-046, V4-047, V4-048, V4-049, W2-048, W4-005, X2-022, W3-046
ST JOHN – CRETE 345 kV Line	Substation conductor	Replace substation conductor	$200,000	V1-024, V1-025, V4-046, V4-047, V4-048, V4-049, W2-048, W4-005, X2-022, W3-046
MICHIGAN CITY- TRAIL CREEK 138 kV Line	Sag limit	Remove Sag Limit	$668,000	W4-005
HONEYCREEK – MONTICELLO 69kV Line	Conductor Limit.	Wind Transmission User Agreement upgrade under construction. Post upgrade rating can accommodate flow	$0	W4-005
HONEYCREEK – SEAFIELD 69kV Line	Conductor Limit.	Wind Transmission User Agreement upgrade under construction. Post upgrade rating can accommodate flow	$0	W4-005

3.2 Out Year (2023) Analysis

Criteria violations were also identified in the Out year analysis for the off peak scenario. The summer peak analysis did not identify any violations. The following table lists the constraints identified. All constraints identified in the analysis violate the affected system's (NIPSCO) local planning criteria.

Table 3-3 Out-Year Constraints

Monitored Element	Cont Flow (MVA)	Rating (MVA)	Loading %	Contingency	Contingency Category	Constraint criteria
NEWCARLISLE – TRAILCREEK 138kV Line	162.3	151	107.5	CE_DUM_WILT_94XFMR	Cat C2	NIPS Facility Impact
MICHIGAN CITY- TRAIL CREEK 138 kV Line	200.2	156	128.3	CE_DUM_WILT_94XFMR	Cat C2	NIPS Facility Impact

Proposed Network Upgrades (NU) for mitigating the constraints identified in the Out-Year (2023) scenario are listed in Table 3-4.

Table 3-4 Proposed Out-Year Network Upgrades

Monitored Element	Constraint	Mitigation	Planning Level Estimate	Queue Projects with Impacts
NEWCARLISLE – TRAILCREEK 138kV Line	Sag limit	Remove Sag Limit	$1,717,000	W4-005
MICHIGAN CITY- TRAIL CREEK 138 kV Line	Sag limit	Remove Sag Limit; Bus Work	$918,000	W4-005

4 Cost Allocation

This Section provides estimated cost of Network Upgrades on a per project basis for the Near-Term and Out-year scenarios. Generation projects X1-096, X2-031, X2-052, X3-051, X4-020, X4-021, X4-025, Y1-015, Y1-030, Y1-035, Y1-036, Y1-065 do not share any Network Upgrades (NU) costs and hence summaries are not provided. The shared cost of Network Upgrades for the impactful generation projects are listed below:

Table 4-1 Near-Term Cost Allocation

Monitored Element	Cost of Upgrade	V1-024	V1-025	V4-046	V4-047	V4-048	V4-049	W2-048	W3-046	W4-005	X2-022
ST JOHN – CRETE 345 kV Line	$200,000	$6,502	$6,503	$5,232	$5,233	$6,952	$6,929	$9,745	$58,636	$64,799	$29,469
MUNSTER - BURNHAM 345 kV Line	$780,000	$22,203	$22,205	$20,221	$20,222	$22,210	$22,259	$40,243	$219,264	$269,478	$121,696
LAPORTE – MICHIGAN CITY 138 kV Line	$2,215,000									$2,215,000	
MICHIGAN CITY- TRAIL CREEK 138 kV Line	$668,000									$668,000	
Total cost	**$3,863,000**	**$28,705**	**$28,707**	**$25,453**	**$25,455**	**$29,161**	**$29,188**	**$49,988**	**$277,899**	**$3,217,277**	**$151,165**

Table 4-2 Out-Year Cost Allocation

Monitored Element	Cost of Upgrade	V1-024	V1-025	V4-046	V4-047	V4-048	V4-049	W2-048	W3-046	W4-005	X2-022
NEWCARLISLE – TRAILCREEK 138kV Line	$1,717,000									$1,717,000	
MICHIGAN CITY- TRAIL CREEK 138 kV Line	$918,000									$918,000	
Total cost	**$2,635,000**									**$2,635,000**	

Appendix A PJM Higher Queued Projects

A.1 PJM November 2012 Cycle

PJM Queue #	ProjectName	State	MISO SH Output	MISO SPK Output	Fuel Type
Q39	Kewanee 138kV	IL	105	21	wind
Q49	Dresden 345kV	IL	45	45	nuclear
Q50	Dresden 345kV	IL	58	58	nuclear
Q51	Quad City 345kV	IL	30	30	nuclear
Q57	Steward-Waterman 138kV	IL	22	4.4	wind
R16	Lena 138kV	IL	126	25.2	wind
R30	Pontiac Mid-Point 345kV	IL	500	100	wind
R33	Nelson 345kV	IL	0	600	natural gas
S27	Blue Mound I	IL	198	39.6	wind
S28	Blue Mound II	IL	198	39.6	wind
S36	Kankakee 138kV	IL	175	35	wind
S37	Kankakee 138kV	IL	175	35	wind
S55	Zion 345kV	IL	0	510	natural gas
S57	Hvdc	IL	3500	1192	HVDC
S62	LaSalle-Braidwood 345kV	IL	500	100	wind
U1-054	Calumet	IL	0	54	natural gas
U3-031	Lincoln Generating Facility	IL	0	40	natural gas
U4-033	University Park North	IL	0	36	natural gas
05MLCS	Meadow Lake	IL	600	120	wind
Q01, Q03	Fowler Ridge	IN	750	150	wind

A.2 PJM May 2013 Cycle

PJM Queue	PJM POI	State	MISO SH Output	MISO SPK Output	Fuel
T130	Convoy – East Lima 345kV	OH	300	60	wind
T131	Lincoln – Sterling 138kV	OH	150	30	wind
T142	Southwest Lima – Marysville 345kV	OH	300	60	wind
T143	Hennepin 138kV	IL	250	50	wind
T148	Caledonia Wind II 100 MW	IL	100	20	wind
T94	Cook – Palesades 345kV	MI	0	1035	natural gas
T99	Caledonia Wind 100 MW	IL	100	20	wind
U2-028A_AT1	Ironville 138kV	OH	135	135	other
U2-072	East Lima – Marysville 345kV	OH	300	60	wind
U3-021	Silver Lake – Cherry Valley 345kV	IL	0	100	natural gas
U4-027	Normandy-Kewanee 138kV	IL	0	100	natural gas
V1-011	Haviland 138kV	OH	100	20	wind
V1-012	Haviland 138kV	OH	150	30	wind
V2-006	East Leipsic 138kV	OH	150	30	wind
V3-007	Desoto-Tanners Creek #1 345kV	IN	200	40	wind
V3-008	Desoto-Tanners Creek #1 345kV	IN	200	40	wind
V3-009	Desoto-Tanners Creek #1 345kV	IN	200	40	wind
V4-010	Tiffin Center 138kV	OH	200	40	wind
V4-015	Fostoria Central 138kV	OH	66.6	13.32	wind
V4-016	Valley 138kV	MI	200	40	wind
W1-072A_AT5	Lemoyne 345kV	OH	0	40	natural gas
W2-001	Fostoria Central 138kV	OH	66.6	13.32	wind
W3-059A_At6	Avery – Greenfield 138kV	OH	99	19.8	wind
W3-088	South West Lima 345kV	OH	200	40	wind
W3-128	Sporn – Waterford 345kV	OH	0	652	natural gas
W3-170	Buckskin 69kV	OH	0	12	solar
X1-027A_AT12	Davis Besse – Beaver 345kV	OH	500	100	wind
Y1-006	Jubal Early – Austinville 138kV	VA	72	14.4	wind
Y1-069	Bay Shore – Fostoria Central 345kV	OH	0	799	natural gas